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IS 10000-3 (1980): Methods of tests for intrnal combustion engines, Part 3: Measuremnts for testing-units and limits of accuracy [TED 2: Automotive Primemovers]

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UDC 621·43·018·6 : 620·1·088·3 (Second Reprint OCTOBER 1990) **IS : 10000 (Part III) - 1980**

Indian Standard

(Reaffirmed 2001)

METHODS OF TESTS FOR INTERNAL COMBUSTION ENGINES

PART III MEASUREMENTS FOR TESTING — UNITS AND LIMITS OF ACCURACY

Internal Combustion Engines Sectional Committee, EDC 14; Methods of Test and Codes of Practice for Engines Subcommittee, EDC 14 : 3 [Ref : Doc : EDC 14 (3124)]

1. Scope — Specifies the units and limits of accuracy for the purpose of measurement of test parameters of constant speed and variable speed internal combustion engines.

2. Measurement Conditions and Definitions of Degree of Accuracy

2.1 *Operating Conditions*

2.1.1 Before a set of measurements is commenced, the engine shall have operated at particular load and speed for a sufficient length of time to ensure that the operating temperatures have reached stable conditions as laid down by the manufacturer.

2.1.2 During the period in which a set of measurements is being made, the load, the speed and all the fluid temperatures and pressures shall be maintained constant within limits of accuracy of measurement given in **3**, col 5.

2.2 *Methods of Measurement* — Are generally selected by the manufacturer and, if necessary, may be subject to agreement between the manufacturer, user, and/or inspecting authority.

2.3 *Accuracy of Measurement* — Includes the accuracy of instrument being used, involves correctness of location of the instrument, the conditions under which it is used and the interpretation of the results obtained.

2.3.1 Where the total accuracy involves measurements of a number of quantities, each with its own accuracy, or where individual measurement is dependent on several parameters, each with its own accuracy, the overall accuracy is taken as the square root of the sum of the squares of the separate accuracies, each multiplied by an appropriate factor equal to the exponent of its parameter in the formulae.

2.3.2 The accuracies given in **3** are considered adequate for most acceptance tests. Manufacturers may adopt greater accuracy of measurements for:

a) Type tests, and
b) Special contractual or legislative requirements.

2.3.2.1 Where measurements are used in subsequent calculations, accuracies greater than those specified for the measured parameters may be chosen to achieve the specified accuracy for the final calculated parameters.

2.3.3 The degree of accuracy assumes that the instruments selected are operating within their range of maximum accuracy.

2.3.4 All measuring instruments and apparatus used during tests shall be checked and calibrated over the range of expected readings.

2.4 *Dynamometer Balance, Calibration and Sensitivity*

2.4.1 Scales shall be checked for zero scale reading with the dynamometer frame in neutral position.

2.4.2 Calibration of the dynamometer with the engine running at some fixed (beam) load, for example, 445N, may be checked by the addition of a 445N weight to the opposite side which should bring the scale back to zero reading. This shall be done for several different loads within the range of expected operation and shall be repeated under static conditions. The result obtained shall be accurate within plus or minus one-half percent of the observed full load reading.

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2.4.3 Hydraulic brakes, electric dynamometers or other similar appliances for measurement of torque shall be statically calibrated by suspending weights on a lever arm of constant length or by other suitable methods. Electric dynamometers shall be calibrated for both ' brake ' and ' motoring ' positions.

2.4.4 Sensitivity of dynamometer and scale shall be checked by adding small increments of weight until the pointer moves a readable amount. The magnitude of this weight, which is the *sensitivity*, shall not exceed one fourth percent of the observed full load reading. Several points shall be checked within the operating range.

2.5 *Exhaust Gas Opacimeter Accuracy* — The indicating dial of the opacimeter shall enable an absorption coefficient of $1{\cdot}7\mathrm{m}^{-1}$ to be read with an accuracy of $0{\cdot}025\mathrm{m}^{-1}$. [For details *see* IS : 10000 (Part X) - 1980 Methods of tests for internal combustion engines: Part X Tests for smoke levels, limits and corrections for smoke levels for variable speed engines.]

3. Units and Limits of Accuracy

Clause	Parameter	Unit	Symbol	Limits of Accuracy
(1)	(2)	(3)	(4)	(5)
	General Parameters			
3.1	Engine speed*	rev/min	n	±1 percent
3.2	Engine driving shaft speed	rev/min	n_d	±1 percent
	Pressures			
3.3	Barometric pressure†‡	kPa	p_a	±0·5 percent
3.4	Compression pressure in a cylinder§	kPa	p_a	±5 percent
3.5	Maximum pressure in a cylinder	kPa	p_{Max}	±5 percent
3.6	Exhaust gas pressure in the exhaust pipe	kPa	p_g	±5 percent
3.7	Coolant pressure	kPa	p_{cool}	±5 percent
3.8	Lubricating oil pressure	kPa	p_o	±5 percent
3.9	Fuel pressure	kPa	p_f	±10 percent

*Measured by a tachometer, revolution counter or tachoscope.

†The accuracy of each pressure (except the pressure at 3.3) is given as percentage of the gauge pressure.

‡Measured by spring loaded or fluid type barometers.

§Measured by a recording maximum pressure gauge, mechanical indicator or from an indicator diagram.

Clause (1)	Parameter (2)	Unit (3)	Symbol (4)	Limits of Accuracy (5)
	*Temperatures**			
3.10	Air temperature at the engine or pressure charger inlet (ambient temperature)	K	T_a	± 2 K
3.11	Coolant temperature	K	T_{cool}	± 2 K
3.12	Lubricating oil temperature	K	T_o	± 2 K
3.13	Fuel temperature	K	T_f	± 5 K
3.14	Exhaust gas temperature	K	T_e	± 5 K
	Consumptions†			
3.15	Fuel consumption (Gravimetric method)	g/s	G_f	± 0·5 percent
3.16	Fuel quantity consumption	ml	G_v	± 0·5 ml
3.17	Lubricating oil consumption	g/s	G_o	± 10 percent
3.18	*Time*	s	t	± 0·5 s
	Emissions‡			
3.19	Hartridge smoke value	Hartridge smoke unit	S_H	± 2 units
3.20	Bosch smoke value	Bosch smoke unit	S_B	± 0·2 units
3.21	Exhaust gas opacity	m^{-1}	k	± 0·025 m^{-1}
	Dynamometer§			
3.22	Dynamometer load reading	—	—	± 0·5 percent of full load reading (*see* 2.4.2)
3.23	Sensitivity	—	—	± 0·25 percent load reading (*see* 2.4.4)

*Measured by electrical methods (resistance thermometers or a thermocouple with measuring apparatus) or fluid-type thermometers.

†Consumptions are measured by mass or volume methods, by determining the time during which a given quantity of the fluid is consumed, using normal pressure differential systems or other types of flowmeters.

‡To be measured by a Hartridge smoke meter, Bosch smoke meter or an exhaust gas opacimeter.

§Used for measurement of engine torque and power (calculated from torque and speed).

EXPLANATORY NOTE

The testing and performance of constant speed and variable speed internal combustion engines was earlier covered by the following Indian Standards:

IS : 1600-1960 ' Code for type testing of constant speed internal combustion engines for general purposes ',

IS : 1601-1960 ' Performance of constant speed internal combustion engines for general purposes ',

IS : 1602-1960 ' Code for type testing of variable speed internal combustion engines for automotive purposes ', and

IS : 1603-1960 ' Performance of variable-speed internal-combustion engines for automotive purposes '.

These standards were originally issued in the year 1960 and as a result of implementation of these standards by the manufacturers of engines and testing laboratories, as also the operation of ISI Certification Marking Scheme, these standards have now been extensively revised.

While IS : 1600 and IS : 1602 covered the codes for type testing of constant and variable speed engines respectively, the performance requirements of such engines were covered by IS : 1601 and IS : 1603, respectively. These standards are now replaced by two sets of standards, one set covers the methods of testing of engines and the other covers the specification and performance requirements of both constant speed and variable speed engines.

The standard covering methods of tests is being published in following 12 parts (each part covering a particular test method or information related to methods of tests):

IS : 10000	Part I Glossary of terms relating to test methods
IS : 10000	Part II Standard reference conditions
IS : 10000	Part III Measurements for testing — units and limits of accuracy
IS : 10000	Part IV Declarations of power, efficiency, fuel consumption and lubricating oil consumption
IS : 10000	Part V Preparation for tests and measurements for wear
IS : 10000	Part VI Recording of test results
IS : 10000	Part VII Governing tests for constant speed engines and selection of engines for use with electrical generators
IS : 10000	Part VIII Performance tests
IS : 10000	Part IX Endurance tests
IS : 10000	Part X Tests for smoke levels, limits and corrections for smoke levels for variable speed engines
IS : 10000	Part XI Information required with inquiry or order and information supplied by the manufacturer with the engine
IS : 10000	Part XII Test certificates.

This standard will be complementary to specifications for performance requirements of different types of engines covered by following standards:

IS : 10001	Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kW)
IS : 10002	Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (above 20 kW)
IS : 10003	Specification for performance requirements for variable speed compression ignition (diesel) engines for automotive purposes
IS : 10004	Specification for performance requirements for variable speed spark ignition engines for automotive purposes

Spark ignition engines for sprayers and similar applications have been covered by IS : 7347-1974 ' Specification for performance requirements of small size spark ignition engines for sprayers and similar applications '.

Two-stroke spark ignition engines for automotive applications which were earlier covered by IS : 1603 will be covered by a separate specification.

The revised methods of tests covered by IS : 10000 (Part I to Part XII) have been aligned with the current international practices in the field of I. C. engines. These parts are in general agreement with the following ISO standards, issued by the International Organization for Standardization:

a) ISO 3046/I-1975	Reciprocating internal combustion engines — Performance: Part I Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption
b) ISO 3046/II-1977	Reciprocating internal combustion engines — Performance: Part II Test methods
c) ISO 3046/III-1979	Reciprocating internal combustion engines — Performance: Part III Test measurements
d) ISO 2710-1978	Reciprocating internal combustion engines — Vocabulary

This Part III of IS : 10000 is in general agreement with ISO 3046/III-1979. However, the calculated quantities and their limits of accuracies have been deleted. Also the definitions covered by ISO 3046/III-1979 have been covered in IS : 10000 (Part I) - 1980. Many of the parameters which are not applicable to the Indian conditions have not been included from ISO 3046/III-1979, while some additional parameters like smoke levels have been introduced.

IS : 10000 (Part I to Part XII) and IS : 10001, IS : 10002, IS : 10003 and IS : 10004 collectively supersede IS : 1600, IS : 1601, IS : 1602 and IS : 1603.

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 1 MARCH 1985

TO

IS:10000(Part 3)-1980 METHODS OF TESTS FOR INTERNAL COMBUSTION ENGINES

PART 3 MEASUREMENTS FOR TESTING UNITS AND LIMITS OF ACCURACY

(*Page 1, clause 2.4.2, last sentence*) - Substitute the following sentence for the existing:

'The result obtained shall be accurate within plus or minus one-half percent of the observed full load reading of dynamometer.'

(*Page 3, clause 3.16, col 5*) - Substitute '± 0.5 percent' *for* '± 0.5 ml'.

(EDC 14)

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